CLAIMS

1. A power control interface between a power output of an unstable power source such as a wind farm and a power transmission line, comprising:

(a) an electrical energy storage coupled between the unstable power source and the power transmission line to store excess power output when it is above a normal output level of the unstable power source and to release stored electrical energy to add to the power output when it is below the normal output level of the unstable power source;

(b) a control system which receives a power source data signal derived from monitoring the power output of the unstable power source and a transmission line data signal derived from monitoring the power transmission line, and which determines when electrical energy stored in the electrical energy storage is to be released to add to power output to the power transmission line to compensate for conditions of decreased power generation encountered by the unstable power source, or when excess electrical energy generated during conditions of increased power generation encountered by the unstable power source is to be stored in the electrical energy storage; and

(c) an electronic compensation module which receives a control signal from the control system corresponding to its determination and operates to release electrical energy stored in the electrical energy storage to add to power output to the power transmission line to compensate for decreased power source output, and to store excess electrical energy from increased power source output in the electrical energy storage in accordance with said determination.

2. A power control interface according to Claim 1, wherein the power source is a wind farm providing an AC power output, and the power output is stored in a selected one of the group of electrical energy storage devices consisting of ultracapacitors, capacitors, and batteries.

3. A power control interface according to Claim 1, wherein the power source is a wind farm providing an AC power output, and the AC power output is converted by an ac-to-dc

inverter to direct current (DC) for storage in a DC capacitor array or battery.

4. A power control interface according to Claim 1, wherein the control system includes a power source monitoring means, a transmission line monitoring means, and a control calculating means for calculating what the power output of the unstable power source is likely to be over a narrow-band range and for maintaining the release of energy or the storage of energy in the electrical energy storage over the narrow-band range despite power fluctuations of short duration.

5. A power control interface according to Claim 4, wherein the power source is a wind farm, and the control system receives data signals derived from monitoring the power output of the wind farm, and data signals derived from monitoring conditions on the transmission line, and the control system employs system-modeling algorithms to predict narrow-band wind speed conditions.

6. A power control interface according to Claim 5, wherein the control system's algorithms include prediction based on current data on wind farm output and historical data of wind farm output.

7. A power control interface according to Claim 1, wherein the electrical energy storage includes an energy storage circuit, a charge controller at an input side of the energy storage circuit, and a discharge controller at an output side of the energy storage circuit for energy release.

8. A power control interface according to Claim 7, wherein the charge controller and the discharge controller act like double-action gates controlled by signals from the electronic compensation module.

9. A power control interface according to Claim 7, wherein the power source is a wind farm providing an AC power output, and the power output is stored in a selected one of the

group of electrical energy storage devices consisting of ultracapacitors, capacitors, and batteries.

10. A power control interface according to Claim 9, wherein the electrical energy storage is an array of ultracapacitors arranged to store electrical energy in respective stages.

11. A power control interface according to Claim 1, further comprising power electronics circuitry for providing voltage support at the point of connection of the wind farm with the power transmission line by using energy stored in said electrical energy storage.

12. A power control interface according to Claim 11, wherein the power electronics circuitry for providing voltage support is distribution static compensator (D-STATCOM) circuitry.

13. A power control interface according to Claim 1, wherein the control system includes a control mode for fault clearance capability for "riding through" a fault condition on the power transmission line by using energy stored in said electrical energy storage.

14. A power control interface according to Claim 13, wherein the control system receives data signals derived from monitoring the transmission line, and enables the electrical energy storage to release stored energy to maintain power output when a fault condition on the power transmission line is detected.

15. A method of interfacing a power output of an unstable power source such as a wind farm with a power transmission line, comprising:

(a) coupling an electrical energy storage between the unstable power source and the power transmission line to store excess power output when it is above a normal output level of the unstable power source and to release stored electrical energy to add to the power output when it is below the normal output level of the unstable power source;

(b) controlling the electrical energy storage to act with a "shock-absorber" function

based on monitoring the power output of the unstable power source and conditions on the power transmission line, by determining when electrical energy stored in the electrical energy storage is to be released to add to power output to the power transmission line to compensate for conditions of decreased power generation encountered by the unstable power source, and when excess electrical energy generated during conditions of increased power generation encountered by the unstable power source is to be stored in the electrical energy storage.

16. A method of interfacing a power output of an unstable power source according to Claim 15, further comprising calculating what the power output of the unstable power source is likely to be over a narrow-band range, and maintaining the release of energy or the storage of energy in the electrical energy storage over the narrow-band range despite power fluctuations of short duration.

17. A method of interfacing a power output of an unstable power source according to Claim 16, wherein the power source is a wind farm, and calculating the likely power output of the wind farm is based on monitoring current power output of the wind farm and using historical wind farm data, and employing system-modeling algorithms to predict narrow-band wind farm output based therein.

18. A method of interfacing a power output of an unstable power source according to Claim 15, wherein the electrical energy storage includes an energy storage circuit, a charge controller at an input side of the energy storage circuit, and a discharge controller at an output side of the energy storage circuit for energy release, and wherein the charge controller and the discharge controller act like double-action gates.

19. A method of interfacing a power output of an unstable power source according to Claim 15, further comprising providing for voltage support at the point of power injection with the power transmission line by using energy stored in the electrical energy storage.

20. A method of interfacing a power output of an unstable power source according to Claim 15, further comprising providing for fault clearance capability for "riding through" a fault condition on the power transmission line by using energy stored in the electrical energy storage.

5